WATER RESOURCES RESEARCH GRANT PROPOSAL

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Title: Transport and Fate of Iron Nanoparticles in Groundwater

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Abstract

Groundwater pollution remains a difficult environmental problem in Ohio and the nation as a whole. Although extensive research has been conducted on cleaning-up groundwater contamination, remediation at many sites is still infeasible or prohibitively expensive with the technology available. The use of iron nanoparticles for groundwater remediation has recently emerged as an exciting new technology with great potential. These particles are extremely reactive, inexpensive, and nontoxic. By injecting iron nanoparticles directly into the groundwater a wide variety of pollutants can be rapidly reduced into nontoxic products. Although the kinetics of these reaction have been studied, very little is known about the transport and fate of these iron nanoparticles in groundwater. In this work, we will test the transport characteristics of these nanoparticles through soil columns and assess how the nanoparticles degrade over time under natural conditions. First, three types of nanoparticles will be synthesized and pollutant transformation rates and nanoparticle degradation rates assayed. Next, particles will be injected into flow through soil columns under a variety of conditions including, different soil types, pH, and dissolved oxygen concentrations. Deposition rates and changes in hydraulic conductivity will be assessed for different nanoparticle injection rates. Finally, nanoparticles will be

injected into contaminated columns to determine their overall transport and fate. A mathematical model will be developed to depict nanoparticle and pollutant advection, dispersion, sorption/attachment, desorption/detachment, and reactions. Results from this work will aid in the fundamental understanding of how these useful nanoparticles behave in the subsurface. This knowledge in turn will help troubleshoot and optimize the technology for different sites.